



IN REPLY REFER TO:

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
National Wildlife Health Center
6006 Schroeder Road
Madison, Wisconsin 53711-6223

August 25, 1998

Dr. E. Frank Bowers
Chief, Division of Wildlife and Habitat Management
U.S. Fish and Wildlife Service
1875 Century Blvd.
Atlanta, Georgia 30345

Pam _____
copies to
OM _____
Grabill _____
Senie _____
Gamble _____

File 98 < species
Black Ducks

File 98 < Refuges
Tennessee

FB

Re: Black Buck Lead Study -
Progress Report

Dear Frank:

Enclosed is our progress report for the first year of the cooperative research study on lead exposure for black ducks in Tennessee. In summary, we found that lead exposure has significantly declined in adult black ducks during the last 10 years. However, lead exposure has not declined in juvenile birds. Overall these are very encouraging and positive results.

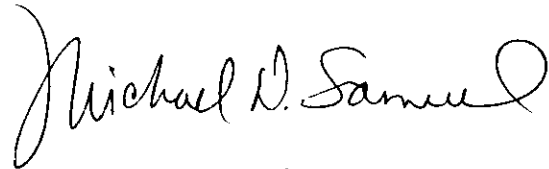
Based on the study results, my recommendation is that the study continue during 1998-99 (as originally planned) for the following reasons. First, there is likely to be some annual variation in the prevalence of lead exposure and a second year of data would strengthen the conclusion that adult exposure has actually declined. Second, further data on juvenile ducks and from Tennessee NWR would strengthen the estimates of lead exposure for these categories. Third, in addition to a reduction in the prevalence of lead exposure for adult black ducks, the data contains indications that lead concentrations in exposed birds (adults and juveniles) have also declined in the past ten years. While this measure is somewhat difficult to interpret biologically, collection of additional data during 1998-99 may clarify whether this apparent trend is valid.

Chief, Div. Of Wildlife & Habitat Management

2

Please contact me if I can clarify any aspects of the progress report or if you wish to discuss my recommendations for 1998-99.

Sincerely,

A handwritten signature in cursive script that reads "Michael D. Samuel". The signature is fluid and elegant, with a large initial 'M' and a distinct 'S' at the end.

Michael D. Samuel
Research Project Leader

Enclosure

Copy to: NWHC Branch Chief, Field Investigations (Brand)
BRD-ERO, Dan James
FWS-Cross Creeks NWR Manager, Jim Wigginton
FWS-Tennessee NWR Manager, John Taylor

NATIONAL WILDLIFE HEALTH CENTER

RESEARCH PROGRESS REPORT (August 1998)

Determination of lead exposure in black ducks wintering in Tennessee
ten years after implementation of non-toxic shot.

Project Cooperators

This research is a cooperative study between the U.S. Fish and Wildlife Service (Region 4) and the USGS-BRD National Wildlife Health Center. Operational funds and staff support were provided by the U.S. Fish and Wildlife Service, USGS-BRD, and the National Wildlife Health Center.

Background

Lead poisoning has long been recognized as an important disease of waterfowl (Bellrose 1959) and was estimated to annually kill from 1.6 to 3.8 million waterfowl in North America (Feierabend 1983). Ingestion of lead shot by waterfowl has been well documented (Sanderson and Bellrose 1986), typically using the prevalence of ingested lead shot in gizzards of hunter-harvested birds. However, this measure of lead poisoning has been questioned because birds with ingested lead shot may be more vulnerable to hunting (e.g., Anderson and Havera 1985; Sanderson and Bellrose 1986, DeStefano 1989). Blood lead is a more sensitive method for measuring lead exposure in live waterfowl (Anderson and Havera 1985), is a better indicator of the amount of lead absorbed by birds, and has been correlated with physiological consequences (Dieter and Finley 1978, Dieter and Finley 1979, Anderson and Havera 1985).

During the winters of 1986 to 1988, 435 black ducks wintering at Cross Creeks and Tennessee NWR's in Tennessee were tested for lead exposure (Samuel et al. 1992). Fifty-one black ducks had blood lead indicative of lead exposure (≥ 0.2 ppm), an 11.7% prevalence. Adult black ducks had exposure rates that were significantly higher than juvenile birds (14.4% vs. 8.2%). However, since 1989 and 1990, non-toxic shot has been required in the vicinity of both Cross Creeks and Tennessee NWR's, respectively.

Research Objectives

1. Determine the current prevalence of blood lead exposure in adult black ducks wintering in Tennessee.
2. Compare current prevalence of blood lead exposure to prevalence obtained during 1986-88.

Research Summary 1997-98

- Blood samples were collected and analyzed for lead concentrations from 317 black ducks banded at Tennessee and Cross Creeks NWR during winter 1997-98. Sixty-three percent (201) of the samples were from adult birds. Males comprised 62% of the samples (196 birds). And 65% of the samples were from Cross Creeks NWR.
- Blood lead concentrations exceeded the exposure threshold (≥ 0.2 ppm) for 19 black ducks (6% of 317). There were no significant differences in the prevalence of ducks exposed to lead or in the median blood lead concentrations for exposed birds based on refuge where birds were captured, or on age and sex of the birds.
- Prevalence of adult black ducks exposed to lead in 1997-98 was 5.5% (95% CI = 3.8% - 7.1%) compared with a prevalence of 14.4% (95% CI = 12.2% - 16.6%) from 10 years ago. Prevalence of exposure to lead has significantly declined for adult birds in the past 10 years. Prevalence of exposure to lead has not significantly declined in juvenile black ducks between 1997-98 (6.9%) and 10 years ago (8.2%).

Research Activities & Results 1997-98

During December 1997, research staff from NWHC traveled to Tennessee to provide training to FWS refuge staff on procedures for obtaining blood samples from waterfowl, handling, and storage of blood for lead concentration analyses. During December and January, refuge staff captured and banded black ducks at Cross Creeks and Tennessee NWR's. One to 2 ml of blood were obtained from the jugular vein with a 3 cc syringe. Blood was dispensed into a 2 cc vacutainer tube containing EDTA. The vacutainer sample was gently mixed, labeled, and frozen. Frozen blood samples from black ducks were shipped to NWHC for chemical analysis of lead concentrations. Some blood samples were damaged during shipping and could not be tested.

Blood samples were analyzed for lead concentrations using the following method. The blood sample was diluted ten-fold in a mixture of 0.5% alkylaryl polyether alcohol (Triton X-100, J.T. Baker Chemical Company, Phillipsburg, New Jersey USA) and 0.2% ammonium dihydrogen phosphate. The diluted samples were stirred immediately prior to the assay. Lead concentrations were determined using a Thermo Jarrell Ash (TJA) model 188 graphite furnace with a TJA DS-2000 autosampler coupled to a TJA Scan-1 atomic absorption spectrophotometer (Thermo Jarrell Ash Corporation, Franklin, Massachusetts USA). This is essentially the same procedure used to analyze blood sampled collected 10 years earlier, with the exception of updated assay equipment.

Blood lead concentrations ≥ 0.2 ppm were considered to represent exposure to lead above the normal background levels (Friend 1985). Birds were classified as either exposed (≥ 0.2 ppm) or unexposed (< 0.2 ppm) to lead. A stepwise logistic regression (Dixon et al. 1985) was used to evaluate factors influencing the proportion of birds exposed. The median blood lead concentrations of exposed birds were compared using a nonparametric Kruskal-Wallis test (Daniel 1978) by analysis of variance on ranks (SAS Institute, Inc., 1987).

In total, 317 blood samples from black ducks were analyzed for lead concentrations. Nineteen samples (6%) had lead values exceeding the 0.2 exposure threshold. At Cross Creeks NWR, 205 blood samples were collected and 11 (5.4%) were in the exposed category. At Tennessee NWR, 112 blood samples were collected and 8 (7.1%) were in the exposed category. Blood samples were analyzed from 201 adult and 116 juvenile black ducks; 11 adults (5.5%) and 8 juveniles (6.9%) were in the exposed category. More blood samples were collected from male black ducks than females (196 males and 121 females); 13 males (6.6%) and 6 females (5%) were in the exposed category.

Median blood lead concentrations for exposed birds were similar by refuge ($P = 0.40$), age ($P=0.17$), and sex ($P=0.63$); however, the number of exposed birds in these tests were small. Median blood lead concentrations for exposed birds were also compared for blood samples collected recently (1997-98) and samples collected 10 years previous (1986-88). We found similar concentrations of lead in exposed birds from the 10-year-old and recent samples for Cross Creeks NWR ($P=0.33$), Tennessee NWR ($P=0.50$), adult birds ($P=0.18$), juvenile birds ($P=0.87$), males ($P=0.46$), and females ($P=0.52$). Although no significant differences were found between 10-year-old and recent blood samples, all the comparisons showed that median concentrations were numerically lower in the 1997-98 samples.

Based on blood samples collected in 1997-98, logistic regression analysis found no differences in exposure to lead between refuges ($P=0.53$) or based on age ($P=0.54$) and sex ($P=0.61$) of the birds. A chi-square analysis was used to compare the proportions of adult and juvenile black ducks exposed to lead from the 10-year-old and recent samples. The proportion of juvenile black ducks with blood concentrations indicating lead exposure were similar ($P=0.69$) among the 2 time periods. However, the proportion of adult black ducks with blood concentrations indicating lead exposure was significantly lower ($P=0.002$) for the 1997-98 samples (5.5%) compared to the 10-year-old samples (14.4%).

References

- Anderson, W. L., and S. P. Havera. 1985. Blood lead, protoporphyrin and ingested shot for detecting lead poisoning in waterfowl. *Wildlife Society Bulletin* 13:26-31.
- Bellrose, F. C. 1959. Lead poisoning as a mortality factor in waterfowl populations. *Illinois Natural History Survey Bulletin* 27:235-288.
- Daniel, W. W. 1978. *Applied nonparametric statistics*. Houghton Mifflin Company, Boston, Massachusetts. 503pp.
- DeStefano, S. 1989. Ecological relationships of lead exposure in Canada geese of the Eastern Prairie population. Ph.D. Thesis. University of Idaho, Moscow, Idaho. 97pp.
- Deiter, M. P., and M. T. Finley. 1978. Erythrocyte δ -aminolevulinic acid dehydratase activity in mallard ducks: Duration of inhibition after lead shot dosage. *Journal of Wildlife Management* 42:621-625.

- Deiter, M. P., and M. T. Finley. 1979. δ -aminolevulinic acid dehydratase enzyme activity in blood, brain, and liver of lead-dosed ducks. *Environmental Research* 19:127-135.
- Dixon, W. J., M. B. Brown, L. Engelman, J.W. Frane, M. A. Hill, R. I. Jennrich, and J. D. Toporek. 1985. BMDP statistical software. University of California Press, Berkeley, California. 734pp.
- Feierabend, J. S. 1983. Steel shot and lead poisoning in waterfowl. National Wildlife Federation. Scientific and Technical Series 8, Washington, D.C. 62pp.
- Sanderson, G. C., and F. C. Bellrose. 1986. A review of the problem of lead poisoning in waterfowl. Illinois Natural History Survey Special Publication 4, Champaign, Illinois. 34pp.
- Samuel, M. D., E. F. Bowers, and J. C. Franson. 1992. Lead exposure and recovery rates of black ducks banded in Tennessee. *Journal of Wildlife Diseases* 28:555-561.
- SAS Institute, Inc. 1987. SAS/STAT guide for personal computers. Version 6. SAS Institute, Inc., Cary, North Carolina. 1,028pp.

Prepared by:

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August 24, 1998